Int J Cardiovasc Imaging (2010) 26:109–110
DOI 10.1007/s10554-009-9530-6

EDITORIAL COMMENT

Prospective helical acquisition for coronary CT angiography

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Received: 29 October 2009 / Accepted: 30 October 2009 / Published online: 18 November 2009

Abbreviations

CAD	Coronary artery disease
CT	Computed tomography
ECG	Electrocardiogram

Noninvasive detection of coronary artery disease (CAD) using computed tomography (CT) with multiple detector rows has high sensitivity and negative predictive value [1, 2] and is thus considered an appropriate clinical option to reliably rule out CAD in patients with low-to-intermediate pretest likelihood of disease [3]. However, the reported effective doses of coronary CT angiography using retrospective ECG gating are rather high, ranging from about 15 to 20 mSv [4, 5]. Prospective ECG gating with acquisition of axial datasets (also called "step-and-shoot") is an established CT scanning technique that has been used for a long time for coronary artery calcium scoring and has recently also been employed as a very promising concept to reduce the effective dose of coronary CT angiography [6–8].

DeFrance et al. propose prospectively ECG-gated helical (spiral) acquisitions as a very promising new prospective acquisition technique for coronary CT angiography [9]. After helical data acquisition, reconstruction provides axial datasets as for standard retrospective helical acquisitions. The authors show that prospectively ECG-gated helical acquisition has a sufficient image quality while greatly reducing effective dose (mean of 6.9 mSv, range: 2.9–10.7 mSv) compared with standard retrospectively ECG-gated helical acquisition (mean of 16.9 mSv, range: 10.1–25.7 mSv). This is achieved by avoiding exposure-intensive overscanning and increasing the pitch (from about 0.2 to 0.27) using prospective helical acquisition. However, their study lacks an important methodological feature since it would have been even more interesting to compare axial step-and-shoot acquisition and prospectively ECG-gated helical acquisition. Such a comparison is not available and would be most interesting in patients with low heart rates. A significant bias is also introduced into this study by comparing two different patient populations: patients with higher heart rates were examined using retrospectively ECG-gated helical acquisition whereas the new prospectively ECG-gated technique was used in patients with low heart rates (<65 beats per minute). Of the 29 patients examined in the study using retrospective ECG-gating, only 10 had heart rates below 65 beats per

Editorial Comment on the article of DeFrance et al. (doi: 10.1007/s10554-009-9522-6).

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minute (those in whom functional evaluation was required). Thus, this selection bias in the two groups is not negligible and further studies are required to establish the very interesting concept of prospective helical acquisition for coronary CT angiography.

The main advantage of prospectively ECG-gated helical acquisitions is the possibility to switch to standard retrospective ECG-gating if any type of arrhythmia occurs. This is different from prospectively ECG-gated axial acquisition, where arrhythmia rejection works as follows: scanning is stopped if an arrhythmia occurs and is continued in the next beat. However, in case of frequent arrhythmias, this might take pretty long and most of the contrast agent may have left the coronary arteries before scanning has been completed. Thus, prospectively ECG-gated helical acquisition appears to have an advantage in this regard. But, this advantage is also a disadvantage in terms of effective dose, which will of course increase to a greater extent when switching to standard retrospective ECG-gated helical acquisition becomes necessary. In their study population of 57 patients in whom prospective acquisition was performed, DeFrance and coworkers noted this switch to standard retrospective ECG-gated helical acquisition in only two patients with arrhythmia or a heart rate of over 65 beats per minute. In those patients, however, the effective dose increased to about 20–21 mSv. That is why a comparative study with the axial step-and-shoot scanning is of great interest and the scientific community is encouraged to fill this gap.

The drawback of all prospective acquisition approaches that involve more than one heart beat, including the prospective spiral mode reported by DeFrance et al., is of course the susceptibility to ECG-related artifacts and, which is even more important in heavy patients, table-transition-related artifacts [10]. These artifacts can only be eliminated by avoiding the step portion in the "step-and-shoot" techniques and can be accomplished by imaging in a single heartbeat as recently suggested using either 320-row coronary CT angiography [11, 12] or high-pitch prospective spiral acquisition [13, 14]. However, the scanners required for these two approaches (320-row CT and fast dual-source 64-row CT) are not as widely available as standard 64-row CT scanners. Thus, the concept put forward by DeFrance et al. in the current issue of the *Journal* is of great interest to the cardiovascular imaging community.

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